International Journal of Agricultural
Science and Research (IJASR)
ISSN(P): 2250-0057; ISSN(E): 2321-0087
Vol. 5, Issue 4, Aug 2015, 105-110


# EFFECT OF FOLIAR SPRAY OF $GA_3$ AND NAA ON GROWTH FLOWERING AND YIELD OF CHINA ASTER (*CALLISTEPHUS CHINENSIS* NEES) CULTIVARS

**M. K. SHARMA[1] & K. I. JOSHI[2]**

[1]College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University (SDAU), Tharad, Gujarat, India

[2]Department of Horticulture, AAU, Anand, Gujarat, India

## ABSTRACT

Effect of foliar spray of plant growth regulators viz., gibberellic acid ($GA_3$) and 1-Naphthaleneacetic acid (NAA) on yield and quality parameters on three China aster cultivars viz., Kamini, Poornima and Violet Cushion was investigated. The treatment of foliar spray of NAA (25 and 50 ppm) and $GA_3$ (150 and 250 ppm) was given at thirty and forty days after transplanting. Among the foliar application treatments, $GA_3$ @ 250 ppm foliar spray significantly increased plant height, leaf area per plant and number of leaves per plant, induced early emergence of flower bud to full blooming of flowers, longer duration of flowering, improved flower longevity, flower fresh and dry weight, flower diameter and enhanced flower yield in terms of number of flowers per plant and flower weight per plant. Among different cultivars, significantly early bud emergence to full blooming of flowers and flower longevity on plant, higher diameter of flower and fresh and dry weight of ten flowers was observed in cv Poornima. However, cv. Kamini showed significantly higher plant height and leaf area as well as longer flowering duration and weight of flowers per plant, while number of flowers per plant was observed maximum in cv Violet Cusion, which being at par with cv Kamini. Thus, among all treatment combinations, the foliar application of $GA_3$ @ 250 ppm with cv Kamini proved superior in terms of growth, flowering and yield attributes viz. plant height, leaf area per plant, duration of flowering, number of flowers per plant and weight of flowers per plant flowers per plant, while with cv. Poornima it induced earliest flower bud emergence and full blooming, heaviest flowers by fresh and dry weight, larger sized flower and enhanced flower longevity.

**KEYWORDS:** China, Aster, $GA_3$, NAA, Flowers, Leaf, Area

## INTRODUCTION

China aster is one of the important annual flower crop mainly cultivated for loose flower production, it also used as cut flower as well as in landscape gardening. Flower quality in terms of flower weight, flower diameter, flower longevity as well as flower quantity are important parameters to be focused in commercial flower production. Flower quality and quantity are influenced by over all plant growth and governed by internal factors like nutritional and hormonal balance. Although, plant hormones are produced in minute quantity, they are known to play important role in influencing plant physiology that further regulates plant growth and development. Hence, plant growth regulators can further be used to manipulate plant growth and development. Gibberellic acid has been reported to increase plant height, leaves and flower quality in marigold (Lal and Mishra, 1986), in carnation (Kumar et al., 2003), in chrysanthemum (Sharma et al., 2003). Similarly, NAA has been reported to modify plant growth and flower yield in carnation (Mukhopadhyay, 1990). Further, information on varietal response of different cultivars to plant growth regulators in China aster is meager. Hence, the

present investigation was undertaken to evaluate suitable variety of China aster and concentration of these plant.

## MATERIALS AND METHODS

Studies were carried out at Department of Horticulture, B.A. College of Agriculture, AAU, Anand in the rabi season. The cultivars subjected were Kamini ($V_1$), Poornima ($V_2$) and Violet Cushion ($V_3$). There were five treatments, i.e. control ($T_0$), NAA 25 ppm ($T_1$), NAA 50 ppm ($T_2$), $GA_3$ 150 ppm ($T_3$) and $GA_3$ 250 ppm ($T_4$). The spraying was done uniformly by wetting both the surfaces of the leaves thoroughly. Foliar spray of NAA and $GA_3$ was given twice, after 30 days of transplanting and then 10 days later. Teepol was used as surfactant. All the recommended package of practices was followed to raise a good crop. The experiments were laid out in factorial randomized block design with three replications. Ten competitive plants were marked in each net plot per replication and the observations were recorded on various growth, flowering and yield parameters on these plants. The data was statistically analyzed using analysis of variance according to the method described by Panse and Sukhatme (1978).

## RESULTS AND DISCUSSIONS

It is evident from Table 1 that vegetative growth of China aster was markedly influenced by the foliar spray of $GA_3$ and NAA. Plant height was increased with increasing concentration of $GA_3$ and the significantly maximum plant height was recorded with treatment $GA_3$ 250 ppm (56.18 cm). The increased plant height is result of rapid elongation of internodes by both cell division and cell elongation (Krishnamoorthy, 1981). The mechanism involving the conversion of starch to sugar was inferred by analogue with known effect of $GA_3$, which increases the height of the plant. Increase in height of plant due to $GA_3$ treatment has also been reported by Reddy and Sulladmath (1983) in China aster; Padmapriya and Chezhiyan (2002) and Sharma et al. (2003) in chrysanthemum; Sindhu and Verma (1998) and Khan and Tewari (2003) in dahlia and Lal and Mishra (1986) in marigold. On the contrary, significantly inverse trend of plant height was observed with increasing concentrations of NAA over control. Such pronounced growth inhibition and suppression with application of NAA has also been reported in China aster (Reddy and Sulladmath, 1983) and in carnation (Mukhopadhyay, 1990). All three cultivars under study showed significant variation in plant height and it was maximum in cv. Kamini (55.15 cm), followed by Violet Cushion (46.05 cm) and Poornima (41.43 cm). Being a genetically controlled factor, the plant height varied among the cultivars. Similar variation in plant height due to cultivars was also noticed previously in China aster (Rao and Negi, 1990 and Kumar et al., 2003), in chrysanthemum (Kanamadi and Patil, 1993 and Mishra, 1998) and in marigold (Janakiram and Rao, 1991). The interaction between cultivar and growth regulators concentrations was significant for plant height and maximum plant height (63.60 cm) was recorded under 250 ppm $GA_3$ with the cultivar Kamini, being at par with 150 ppm $GA_3$ with the cultivar Kamini (60.30 cm).

Increasing concentration of $GA_3$ resulted in a linear increase in the leaf area per plant as well as number of leaves per plant (Table 1). Significantly maximum number of leaves (392.03) and leaf area (3968.88 $cm^2$) per plant was obtained under foliar spray of $GA_3$ at 250 ppm. Among the cultivars, Violet Cushion recorded significantly maximum count of leaves (353.44), being at par with cv Kamini (336.40), but interestingly significantly largest leaf area (3814.94 $cm^2$/plant) was recorded with cv. Kamini. Among the interactions, significantly higher number of leaves per plant (414.67) was produced by $T_4V_3$, being at par with $T_3V_3$, $T_4V_2$, $T_4V_1$ and $T_3V_1$. The significantly larger leaf area was noticed in $T_4V_1$ (4208.27 $cm^2$). Increase in leaf area with $GA_3$ foliar spray can be attributed to increase in height of plant, more number of leaves per plant and genetic makeup of cultivars. These findings are corroborated by Kulkarni and Reddy (2003) in

chrysanthemum. Ogale et al. (1996) noticed $GA_3$ promoted plant height, internodal length, leaf size, leaf number in coreopsis (Coreopsis tinctoria Nutt) plant. Foliar spray of NAA did not have any marked effect on vegetative growth and similar finding also noticed by Das et al., 1999 in salvia and increasing levels of NAA inhibited linear growth of carnation (Mukhopadhyay, 1990) and China aster (Reddy and Sulladmath, 1983).

Table 2: elucidates that foliar spray of growth regulators exerted significant effect on flower bud emergence and time taken for first full blooming. Foliar spray of $GA_3$ 250 ppm induced significantly earliest flower bud initiation (52.78 DAT) and took shortest time for first full blooming (67.44 DAT). The cv. Poornima was produce its earliest visible flower bud (41.87 DAT) and earliest full blooming (59.73 DAT. Among the various treatment combinations, $T_4V_2$ showed significantly earlier flower bud initiation (34.67 DAT) and full blooming (48.00 DAT), being at par with $T_3V_2$ for earlier visible bud formation. This might be due to advanced blooming nature of cv. Poornima (Janakiram and Rao, 2002 and Kumar et al, 2003) and the increased photosynthesis and respiration along with enhanced fixation by $GA_3$ that led to early flower bud initiation (Sen and Sen, 1968).

The influence of growth regulators on duration of flowering was found to be significant and was maximum with foliar spray of $GA_3$ 250 ppm (82.68 days). Among the cultivars, significantly maximum duration of flowering was recorded in cv. Kamini (85.00 days). Among interactions, foliar spray of $GA_3$ at 250 ppm resulted in the maximum duration of flowering with cv Kamini (92.33 days). Earliness in flowering with extended flowering duration caused by $GA_3$ application is in consonance with the finding of Dutta and Seemanthini (1998) in chrysanthemum.

The foliar spray of $GA_3$ and NAA influenced significantly the fresh weight and dry weight of ten flowers over control and the significantly higher fresh weight of ten flowers (28.23 g) and dry weight of ten flowers (4.49 g) was recorded with foliar spray of $GA_3$ 250 ppm, being at par with $GA_3$ 150 ppm for flower fresh weight (26.77 g). Among cultivars, Poornima gained significantly maximum fresh weight (35.82 g/10 flowers) and dry weight (5.07 g/10 flowers). Among the interactions, significantly higher 10 flowers fresh weight (37.32 g) was gained by $T_3V_2$, being at par with $T_4V_2$ (37.02). The data regarding the flower diameter reveals that there was remarkable influence of growth regulators treatments and the significantly bigger sized flower was observed with application of treatment $GA_3$ 250 ppm (5.73 cm), being at par with $GA_3$ 150 ppm (5.70 cm). Among cultivars, Poornima recorded significantly maximum diameter of flower (5.64 cm), being at par with cv. Kamini (5.56 cm). Increase in diameter might be due to active cell elongation in the flower which resulted in increased flower diameter. $GA_3$ is also known to increase the sink strength of the actively growing parts. This variation among the cultivars for fresh and dry weight of ten flowers was mainly because of increased flower size with prominent central disc floret in cv. Poornima. Further, being a genetical factor, variations were expected among the cultivars of China aster.

Foliar spray of $GA_3$ and NAA significantly prolonged the longevity of flower over control as shown in Table 4. Flower longevity was maximum $GA_3$ 150 ppm (20.11 days), being at par with NAA 25 ppm (20.00) and $GA_3$ 250 ppm (19.22 days). Among the cultivars, Poornima recorded significantly longest longevity period of flower on plant (21.73 days). The significantly longer longevity of flower was observed with foliar spray of $GA_3$ 250 ppm with cv. Poornima (24.00 days), being at par with $GA_3$ 150 ppm with cv. Poornima (23.67 days). Increase in flowering period and flower longevity due to $GA_3$ and NAA has earlier also been documented by Padmapriya and Chezhiyan (2002) in chrysanthemum and Kumar and Singh (2003) in carnation.

Foliar sprays of $GA_3$ 250 ppm recorded significantly maximum number of flowers (55.78) and weight of flowers (117.97 g) per plant. The differences among the cultivars with respect to number of flowers per plant were significant and the higher count of flowers per plant was recorded in cv. Violet Cushion (57.79), being at par with cultivar Kamini (56.58). Among the cultivars, the significantly higher weight of flowers per plant was recorded in cv. Kamini (104.35 g/plant), being at par with cv Violet Cushion (100.43 g/plant). The interaction effect of TxV was recorded significant variation for number of flowers and weight of flowers per plant and was maximum with $T_4V_1$ (70.00 and 132.84 g/plant, respectively). Increase in number of flowers and yield per plant as a result of $GA_3$ treatment might be explained in light of the fact that $GA_3$ treatment resulted in marked increase in the plant height and leaf area per plant, which improve source to sink ratio. Production of more number of flowers with $GA_3$ was also observed by Jayanthi and Gowda (1991) and Kumar et al. (2003) in China aster. Moreover, the finding of Poshiya et al. (1995) in chrysanthemum is in accordance with the results observed in current investigation in case of NAA.

## CONCLUSIONS

From this study, it can be concluded that the foliar application of $GA_3$@ 250 ppm with cv Kamini proved superior in terms of growth, flowering and yield attributes viz. plant height, leaf area per plant, duration of flowering, number of flowers per plant and weight of flowers per plant flowers per plant, while with cv. Poornima it induced earliest flower bud emergence and full blooming, heaviest flowers by fresh and dry weight, larger sized flower and enhanced flower longevity.

**Table 1: Influence of Foliar Spray of $GA_3$ and NAA on Plant Height, Number of Leaves and Leaf Area per Plant on China aster (Callistephus Chinensis Nees) Cultivars**

| Treatment | Plant Height (Cm) | | | | Number of Leaves Per Plant | | | | Leaf Area ($Cm^2$) Per Plant | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Kamini ($V_1$) | Poornima ($V_2$) | Violet Cushion ($V_3$) | Mean | Kamini ($V_1$) | Poornima ($V_2$) | Violet Cushion ($V_3$) | Mean | Kamini ($V_1$) | Poornima ($V_2$) | Violet Cushion ($V_3$) | Mean |
| Control ($T_0$) | 54.33 | 41.00 | 44.23 | 46.52 | 333.21 | 299.74 | 330.67 | 318.15 | 3593.07 | 3138.17 | 3465.57 | 3398.93 |
| NAA 25 ppm ($T_1$) | 49.93 | 35.77 | 38.33 | 41.34 | 334.00 | 337.67 | 321.53 | 334.11 | 3619.10 | 3188.62 | 3646.33 | 3484.68 |
| NAA 50 ppm ($T_2$) | 47.57 | 33.23 | 39.07 | 39.96 | 281.47 | 244.00 | 317.55 | 282.33 | 3518.67 | 2894.90 | 3418.35 | 3277.31 |
| GA 150 ppm ($T_3$) | 60.30 | 47.53 | 53.27 | 53.70 | 353.07 | 357.30 | 382.79 | 364.38 | 4135.60 | 3605.13 | 3917.32 | 3886.02 |
| GA 250 ppm ($T_4$) | 63.60 | 49.60 | 55.33 | 56.18 | 380.28 | 381.13 | 414.67 | 392.03 | 4208.27 | 3630.37 | 4068.02 | 3968.88 |
| Mean | 55.15 | 41.43 | 46.05 | | 336.40 | 325.99 | 353.44 | | 3814.94 | 3291.44 | 3703.12 | |
| C.D. (P = 0.05) | V | T | V X T | | V | T | V X T | | V | T | V X T | |
| | 1.74 | 2.25 | 4.31 | | 17.17 | 22.16 | 38.39 | | 25.68 | 33.15 | 57.08 | |

**Table 2: Influence of Foliar Spray of $GA_3$ and NAA on Emergence of Flower Bud Full Blooming of Flower and Duration of Flowering on Yield China aster (Callistephus Chinensis Nees) Cultivars**

| Treatment | Emergence of Flower Bud (Days After Transplanting) | | | | Full Blooming of Flower (Days After Transplanting) | | | | Duration of Flowering (Days) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Kamini ($V_1$) | Poornima ($V_2$) | Violet Cushion ($V_3$) | Mean | Kamini ($V_1$) | Poornima ($V_2$) | Violet Cushion ($V_3$) | Mean | Kamini ($V_1$) | Poornima ($V_2$) | Violet Cushion ($V_3$) | Mean |
| Control ($T_0$) | 72.33 | 40.67 | 71.67 | 61.55 | 87.00 | 60.67 | 91.33 | 79.67 | 75.00 | 62.00 | 76.33 | 71.11 |
| NAA 25 ppm ($T_1$) | 75.00 | 46.67 | 85.68 | 69.11 | 99.00 | 67.67 | 99.67 | 88.78 | 86.33 | 66.67 | 78.00 | 77.00 |
| NAA 50 ppm ($T_2$) | 80.33 | 51.33 | 86.33 | 72.67 | 103.33 | 72.00 | 103.00 | 92.78 | 82.67 | 65.00 | 76.33 | 74.67 |
| GA 150 ppm ($T_3$) | 67.00 | 36.00 | 62.33 | 55.11 | 76.33 | 50.33 | 83.67 | 70.11 | 88.67 | 70.33 | 78.00 | 79.00 |
| GA 250 ppm ($T_4$) | 64.00 | 34.67 | 59.67 | 52.78 | 73.33 | 48.00 | 80.00 | 67.44 | 92.33 | 72.67 | 83.00 | 82.68 |
| Mean | 71.33 | 41.87 | 73.13 | | 88.00 | 59.73 | 91.53 | | 85.00 | 67.33 | 78.33 | |
| C.D. (P = 0.05) | V | T | V X T | | V | T | V X T | | V | T | V X T | |
| | 1.14 | 1.47 | 2.55 | | 1.81 | 2.33 | NS | | 1.78 | 2.30 | 3.98 | |

**Table 3: Influence of Foliar Spray of $GA_3$ and NAA on Fresh and Dry of Flowers and Diameter of Flower of China aster (Callistephus Chinensis Nees) Cultivars**

| Treatment | Fresh Weight of 10 Flowers (G) | | | | Dry Weight of 10 Flowers (G) | | | | Diameter of Flower (Cm) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Kamini ($V_1$) | Poornima ($V_2$) | Violet Cushion ($V_3$) | Mean | Kamini ($V_1$) | Poornima ($V_2$) | Violet Cushion ($V_3$) | Mean | Kamini ($V_1$) | Poornima ($V_2$) | Violet Cushion ($V_3$) | Mean |
| Control ($T_0$) | 20.33 | 35.32 | 18.67 | 24.78 | 3.67 | 4.53 | 3.23 | 3.81 | 5.40 | 5.87 | 4.57 | 5.28 |
| NAA 25 ppm ($T_1$) | 20.33 | 34.65 | 18.50 | 24.49 | 4.07 | 4.93 | 2.93 | 3.98 | 5.39 | 4.56 | 4.17 | 4.71 |
| NAA 50 ppm ($T_2$) | 20.67 | 34.79 | 17.67 | 24.38 | 4.08 | 4.70 | 3.02 | 3.93 | 4.76 | 5.59 | 4.00 | 4.78 |
| GA 150 ppm ($T_3$) | 23.00 | 37.32 | 20.00 | 26.77 | 4.17 | 5.47 | 3.23 | 4.29 | 6.12 | 5.97 | 5.00 | 5.70 |
| GA 250 ppm ($T_4$) | 25.00 | 37.02 | 22.67 | 28.23 | 4.33 | 5.73 | 3.40 | 4.49 | 6.12 | 6.21 | 4.87 | 5.73 |
| Mean | 21.87 | 35.82 | 19.50 | | 4.06 | 5.07 | 3.16 | | 5.56 | 5.64 | 4.44 | |
| C.D. (P = 0.05) | V | T | V X T | | V | T | V X T | | V | T | V X T | |
| | 1.69 | 2.18 | 3.78 | | 0.11 | 0.14 | NS | | 0.27 | 0.35 | | |

**Table 4: Influence of Foliar Spray of $GA_3$ and NAA on Number of Flowers and Weight of Flowers Per Plant and Longevity of Flowers on China aster (Callistephus Chinensis Nees) Cultivars**

| Treatment | Longevity of Flower (Days) | | | | Number of Flowers Per Plant (G) | | | | Weight of Flowers Per Plant (G) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Kamini ($V_1$) | Poornima ($V_2$) | Violet Cushion ($V_3$) | Mean | Kamini ($V_1$) | Poornima ($V_2$) | Violet Cushion ($V_3$) | Mean | Kamini ($V_1$) | Poornima ($V_2$) | Violet Cushion ($V_3$) | Mean |
| Control ($T_0$) | 16.33 | 18.00 | 17.67 | 17.33 | 48.10 | 20.35 | 51.40 | 40.28 | 88.20 | 65.00 | 83.98 | 79.06 |
| NAA 25 ppm ($T_1$) | 22.33 | 22.33 | 15.33 | 20.00 | 53.50 | 23.00 | 54.10 | 41.53 | 91.40 | 69.94 | 90.60 | 83.98 |
| NAA 50 ppm ($T_2$) | 19.00 | 20.67 | 16.67 | 18.44 | 51.00 | 22.35 | 57.10 | 43.48 | 90.40 | 69.50 | 92.92 | 84.27 |
| GA 150 ppm ($T_3$) | 19.67 | 23.67 | 17.00 | 20.11 | 60.30 | 28.10 | 61.20 | 49.87 | 118.90 | 92.60 | 113.98 | 108.49 |
| GA 250 ppm ($T_4$) | 17.33 | 24.00 | 16.33 | 19.22 | 70.00 | 33.20 | 64.15 | 55.78 | 132.84 | 100.40 | 120.66 | 117.97 |
| Mean | 18.93 | 21.73 | 16.40 | | 56.58 | 25.40 | 57.79 | | 104.35 | 79.49 | 100.43 | |
| C.D. (P = 0.05) | V | T | V X T | | V | T | V X T | | V | T | V X T | |
| | 1.03 | 1.33 | 2.30 | | 1.27 | 1.63 | 2.83 | | 2.76 | 3.57 | 6.18 | |

## REFERENCES


1. Das, B. C.; Behera, P.; Panda, P.K. and Nayak, B. (1999). Studies on the effect of growth regulators on growth of salvia (Salvia splendens KerGawal). Orissa J. Hort., 27 (2): 5-9.
2. Dutta, J. P. and Seemanthini, Ramdas (1998). Growth and flowering response of chrysanthemum (Dendranthema grandiflora Tzelev.) to growth regulator treatments. Orissa J. Hort., 26 (1): 70-75.
3. Janakiram, T. and Rao, T.M. (1991). Genetic improvement of marigold. In: Floriculture Technology, Trade and Trends. (Ed. Prakash, J. and Bhandary, K.R., Oxford and IBH Co. Pvt. Ltd., New Delhi) pp. 331-335.
4. Janakiram, T. and Rao, T.M. (2002). China aster production technology. (Pub. Reddy, P. P., Director, I.I.H.R., Bangalore- 560 089).
5. Jayanthi, R. and Gowda, J.V.N. (1991). Influence of $GA_3$ on flowering and plant sugar content of China aster (Callistephus chinensis Nees) cv 'Heart of France'. Curr. Pl. Sci. Biotech. Agri., 12: 389-392.
6. Kanamadi, V.C. and Patil, A.A. (1993). Performance of chrysanthemum varieties in the transitional tract of Karnataka. South Indian Hort., 41 (1): 58-60.
7. Khan, F.U. and Tewari, G.N. (2003). Effect of growth regulators on growth and flowering of dahlia (Dahlia variabilis L.). Indian J. Hort., 60 (2): 192-194
8. Krishnamoorthy, H.N. (1981). Auxin and Gibberellins. Plant Growth Substances. Tata McGraw Hill, New Delhi.

9. Kulkarni, Balaji S. and Reddy, Sathyanarayana B. (2003). Effect of growth regulator on chrysanthemum. In Proceedings of National Symposium on "Recent Advances in Indian Floriculture" (held at KAU, Trichur during 12-14 Nov, 2003) pp5-7.

10. Kumar, Prabhat; Raghava, S.P.S.; Misra, R.L. and Singh, K.P. (2003). Effect of $GA_3$ on growth and yield of China aster. J. Orna. Hort., 6 (2): 110-112.

11. Kumar, R. and Singh, K. (2003). Effect of growth regulator and shoot tip pinching on carnation. J. Orna. Hort., 6 (2): 134-136.

12. Lal, H. and Mishra, S.P. (1986). Effect of gibberellic acid and maleic hydrazide on growth and flowering of marigold and aster. Prog. Hort., 18 (1-2): 151-152

13. Mishra, H.P. (1998). Evaluation of small-flowered varieties of chrysanthemum for calcareous belt of North Bihar. Indian J. Hort., 56 (2): 184-188.

14. Mukhopadhyay, A. (1990). Responses of carnation to spray application of NAA and $GA_3$. Haryana J. Hort. Sci., 19 (3-4): 280-83.

15. Ogale, V. K.; Venu-Babu, P. and Mishra, S. D. (1996). GA-induced alterations in the growth and flowering of Coreopsis tinctoria Nutt. J. Orna. Hort., 4 (1-2): 33-38.

16. Padmapriya, S. and Chezhiyan, N. (2002). Effect of gibberellic acid and certain other chemicals on flowering characters of chrysanthemum (Dendranthema grandiflora Tzelev) cultivars. Orissa J. Hort., 30 (2): 47-51.

17. Panse V. G.and Sukhatme, P.V.(1985). Statistical Methods for Agricultural Workers. ( $4^{th}$ ed. ICAR, New Delhi).

18. Poshiya, V. K. ; Kataria, G. K. and Chovatiya, V. P. (1995). Effect of growth regulators on growth and flower yield of Chrysanthemum indicum Linn. cv. 'Mayur'. J. Applied Hort., 1 (1&2): 101-102.

19. Rao, T. M. and Negi, S. S. (1990). Heritable components of biometric characters in China aster. In: Floriculture Technology, Trade and Trends (Ed. Prakash, J. and Bhandary, K. R., Oxford and IBH Co. Pvt. Ltd., New Delhi ) pp. 318-321.

20. Reddy, Y. T. N. and Sulladmath, U. V. (1983). Effect of growth regulators on growth and flowering of China aster (Callistephus chinensis Nees). South Indian Hort., 31 (2-3): 95-98.

21. Sen, P.K. and Sen, S.K. (1968). Effect of growth retarding and promoting chemicals on growth and flowering of some annuals. Indian J. Hort., 25: 219-24

22. Sharma, Bhaskarjyoti; Talukdar, Madhumita Choudhury and Das, Sangita (2003). Quality flower production in chrysanthemum (Dendranthema grandiflora Tzelev) as affected by plant growth regulators. In Proceedings of National Symposium on "Recent Advances in Indian Floriculture" (held at KAU, Trichur during 12-14 Nov, 2003) pp. 20-23.

23. Sindhu, S. S. and Verma, T.S. (1998). Effect of different growth regulators on growth and flowering of Dahlia (Dahlia variabilis) cv. "Powder Puff". Haryana J. Hort. Sci., 27 (2): 81-84.